



Ø BEAT



COLO. SPRINGS.
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DECEMBER 1982

The Computer's Heart... The Microprocessor

And the earth was without form and void and darkness covered the face of the deep... then Intel invented the microprocessor.

This may be a rather gross analogy but the Intel Corporation did indeed herald a new beginning when they quietly and without fanfare introduced the world's first microprocessor. By the late 1960's, they produced the 4004 which was specifically developed for the electronic calculator market. It was a 4 bit, register oriented chip that was ideal for numeric operations.

It didn't take much experimentation by its designers to realize that with a little improvement, the 4004 could be a powerful general purpose microprocessor. Subsequently, in 1971, Intel introduced the 8008, the world's first 8 bit (1 bit = 1 binary digit) microprocessor. The 8008 was essentially a scaled up 4004. The internal architecture was similar to the 4004 except the device was capable of handling 8 bit words (or blocks of bits) rather than 4. This 8 bit block was later standardized to equal one byte.

In 1973, Intel released an improved version of the 8008 called the 8080. Although similar in architecture, one of the strong points of the 8080 was its speed. It could cruise along at a clock rate of 4 MHz, which is much faster than some newer versions of microprocessors in use today. (It is also interesting to note that the going price of the 8080 in 1975 was \$360.00. Now, only seven years later, it can be purchased for less than \$5.00.)

It wasn't until the following year that Intel met its first competition. Motorola released the MC6800. The 6800 was different in programming philosophy in that the instructions were "memory oriented" instead of "register oriented". By doing this, the designers were able to simplify instructions by about 50% to 10 addressing modes. The result was that programmers could program the chip in higher level, more self explicit instructions. Unfortunately, it was at the expense of versatility and speed (1 MHz clock rate typical). The differences became obvious in complex number crunching operations.

Believing that the future of microprocessors would lean toward register oriented instructions, the designers of the 8080 left Intel and formed their own company. In 1975, they introduced the Zilog Z80. The Z80 was an improved version of the 8080. The main differences were additional registers and signals that drive and control the cheaper dynamic RAM's. This competitive edge coupled with the fact that the Z80 was software compatible with the already popular 8080 quickly made the Z80 the most widely used microprocessor on the market. Users of this chip included Radio Shack which even today enjoys the highest unit sales in the world.

Not to be outdone, in 1976 the designers of the Motorola 6800 also left to join a company called MOS Technology a company involved in the manufacture of calculator chips. They redesigned their creation by eliminating a few seldom used instructions and adding more to make a total of 13 addressing modes. They named their chip the 6502. The 6502 was the first microprocessor to employ a technique called "instruction pipelining" previously found only in large scale computers. Pipelining is a technique of stacking up several instructions ahead to greatly reduce system delays while the CPU fetches and executes each instruction. This chip was quickly acclaimed by design experts to be the most advanced available and manufacturers like Apple, Atari and Commodore immediately adapted it for use in their computers. The problem of lack of speed was still present in the 6502 however; the recommended clock rate was still 1 MHz. Even in later versions such as the 6502A (2 MHz) and 6502B (3 MHz), the clock speeds are not very high compared to other recent microprocessor designs.

Of course Motorola was not about to sit by and let their product be upstaged. They also redesigned the obsoleted 6800, added instruction pipelining and added a series of powerful instructions not contained in the 6502. The new MC6809 was now expanded to a total of 19 different addressing modes. Although Motorola now had a technically superior product, the market timing

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ZERO BEAT is published monthly in the interest of the members of the Pikes Peak Radio Amateur Association, Inc., Colorado Springs, Colorado. Permission is given to reprint articles or excerpts provided credit is given. Deadline for submission of articles is the 21st of the month. Classifieds accepted anytime.

The Pikes Peak Radio Amateur Association meets on the second Wednesday of every month at the First United Methodist Church, 420 N. Nevada, at 7:30 p.m. All amateurs and interested parties are invited to attend.

Editor: Don Lohse KB0KQ, 1410 E. LaSalle, Colorado Springs, CO 80907 635-7469

NOVEMBER MEETING MINUTES

The November meeting of the Pikes Peak Radio Amateur Association was called to order at 7:30 p.m. in the basement of the 1st Methodist Church. Members introduced themselves and gave a brief background. A motion to accept the last minutes as printed in Zero Beat was made and unanimously passed. Les reported the treasury had a current balance of \$1,938.95.

Members were advised the Christmas Party would be at the Flying W Ranch Dec. 3rd at 8:00 p.m. The cost is to be \$12.00 per person. Money should be given to Greg KAFOZ by Dec. 1st.

The education committee reported that novice classes are about finished. Upgrade classes are being planned.

Members were asked to submit ideas of a location for April's Swapfest. A large place is needed. Also, advertising needs to start soon. A large door prize will be offered and many tickets will need to be sold. Smaller donations for door prizes are also wanted. Any members wishing to help out should contact Dave, NØDV.

Rosie reminded everyone of the auction Nov. 20th at 1415 S. Tejon. She said there were many items being offered.

Ken, WØTGL reported on the Olympic Committee and the 1983 National Sports Festival. It is a big project and will require lots of manpower. The committee agreed to allow PPRAA to operate a commemorative station during the festival on the Olympic Training Center grounds and they will provide special QSL cards for the event.

The business meeting adjourned at 8:25 p.m. After a short break, Ray AAOL presented a program on SWR. The audience responded with many questions and discussion was quite lively. A number of people hoped to continue the program in the near future.

The meeting adjourned at 10:00 p.m. The next meeting will be December 8th and will feature Homebrew Night.

Respectfully submitted,
Mark, KAØJXW

FOR SALE: Wood office desk 34" deep by 60" wide-\$25. Jim Anderson KJDNE 471-3576 after 5:30 p.m.

MEETING NOTICE

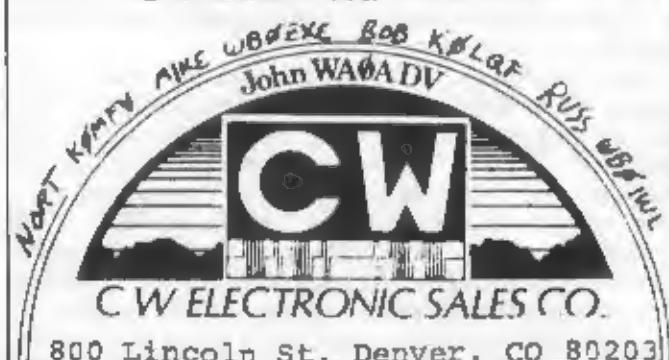
The December meeting of the Pikes Peak Radio Amateur Association will be held on December 8 at 7:30 p.m. at the First United Methodist Church located at the corner of Nevada and Boulder streets. The program is Homebrew Night, with prizes awarded for the best "I made it myself" projects. Come and see what people are building these days. Members and interested persons are encouraged to attend.

FOR SALE — TS 820S w/CW filter, spkr., MC 50 mike \$550 or \$500 w/o mike or spkr. HW 101 w/ p.s., CW filter, & spkr \$300-save \$245 on kit price. Heath HD 1410 keyer \$40-save \$25 on kit cost. Johnson Viking 2 \$150-good AM or lowband CW transmitter. HRO Junior \$150-early HRO model, 1935 vintage, a real antique, w/p.s., all coils and spkr. Mon-Key electronic keyer \$10-one of the first commercial electronic keyers. ASR 33 teletype \$100-very clean, excellent cond., little use. 1DS 125 dot matrix printer \$150-baud rates to 1200, multiple font sizes, parallel or serial Interface. 40 meter folded dipole \$20-w/ low loss wire balun.

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Microprocessors (cont.)

was bad. Most of the large manufacturers had already committed their designs to other microprocessors. IBM, the remaining large manufacturer with uncommitted resources would eventually use a microprocessor which considerably out distances even the 6809. The nemesis of speed and register versatility nagged the 6809 in the same way they affected all preceding memory oriented designs. The clock speed of 2 MHz would soon be bested by a considerable margin.

The answer to how this would be done lies in taking another look at the company that invented the microprocessor, Intel. Like Motorola, they also were not about to sit back and watch their lead in microprocessor design be usurped. On the heels of the 8080, they accomplished their second first. Intel released the 8086, the ultimate 16 bit Microprocessor. It not only had instruction pipelining, but architecturally was a hybrid of microcoded and random logic. This meant it had not only the ease of high order, memory oriented programming but also the versatility of register oriented programming. To top it all off, the 8086 had a clock speed of an incredible 8 MHz. The 8086 quickly became and is still the number one chip used for military and aerospace applications. There are more 8086's floating around in space than all the rest of the microprocessors put together.

After developing the 8086, Intel turned their attention back to the 8 bit microprocessor. They upgraded the 8080 to the 8085. The main differences were the addition of a series of hardware interrupts and direct serial input/output capability. These features make the 8085 an ideal low cost microcontroller. A complete, powerful 85 microcontroller system can be built for under \$25.00. Last but not least, Intel was able to raise the clock rate to 5 MHz. In the latest version, the 8085A-2, the clock rate is an astounding 10 MHz.

Noticing the tremendous success of the 8086, Intel decided to release an 8 bit version for the personal computer market. In 1981 they released the 8088. It incorporated all the best features of the 8086, 16 bit internal architecture including the ALU, hybrid



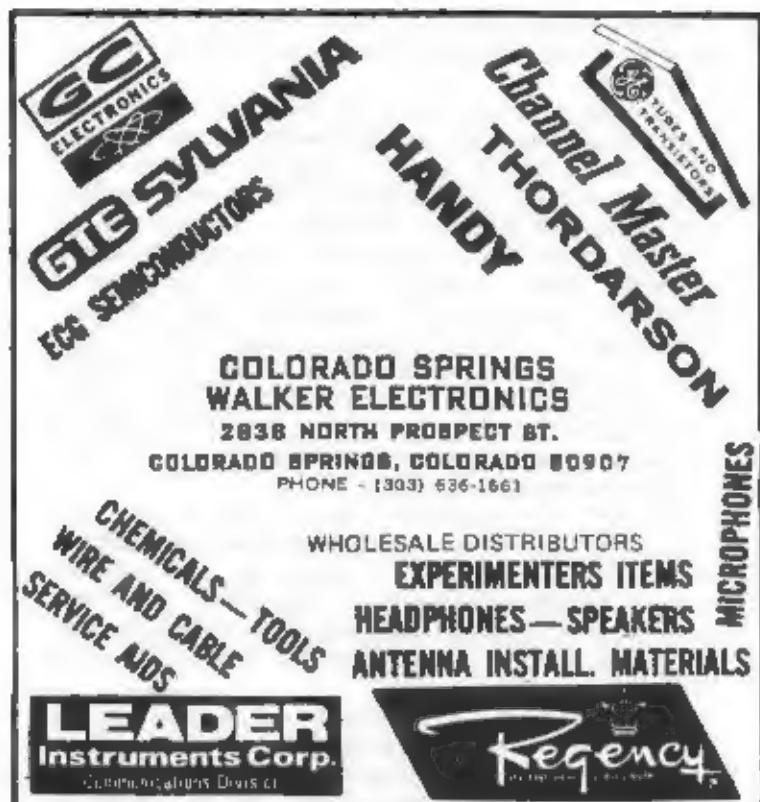
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microcoded and random logic, 8 MHz clock rate and was totally compatible with the inexpensive hardware interface chips of the 8085. The 8088 is today the only 8 bit microprocessor with direct multiply and divide instructions (all others accomplish multiplication by a series of register shifts and additions, and division by register shift and subtractions). With a total of 24 addressing modes, the 8088 not only has powerful high order loop and string functions found in no other microprocessor but also has low order register instructions so useful in scientific processing. In addition, it is the only 8 bit chip with direct addressing capability of 1 megabyte. All the rest are limited to 64 kilobytes.

Almost coincidental with the release of the 8088, IBM decided to create its personal computer division. Historically, IBM has had the corporate attitude of "We'll create the hardware and software our way and let the rest of the world conform to us". But through either dumb luck or a stroke of genius (and I prefer to think the latter) the General Manager of the PC division decided, 1. to use ASCII input instead of IBM EBCDI and 2. to go to the Number 1 PC software house in the nation, Microsoft, and use the generically popular MS DOS operating system.

This stroke of genius caused havoc in the IBM PC division. Upon release of the IBM personal computer on January 15, 1982, the Marketing Department ambitiously forecasted the sale of 100,000 units by December 31, 1982. It was ambitious because the two leaders, Radio Shack and Apple, would both sell less than 500,000 units in the same period. The IBM marketing wizards were wrong. By the end of June, sales exceeded the 100,000 unit mark. They have since revised the 1982 sales forecast to 300,000 units. They will probably exceed that. The latest forecast is 1 million units by January 1, 1984. I have no reason to believe they won't reach that. If they do, it will make them the number one personal computer

(continued on page 4)

Microprocessors (cont.)

company in the world in a period of less than two years. My only comments are: 1. hooray for the Intel 8086 and 2. Buy IBM.

Although Intel had become known as the "speed king" of microprocessors, they were not yet ready to relax. Being aware of the problems that memory oriented microprocessors have with number crunching, they developed the 8087. The 8087 is a 32 bit specialized microprocessor that is specifically designed to process numeric data. Complex concepts such as trigonometrics, exponents, logarithms (both common and natural), radians, floating point and integer conversion are all handled with single line instructions. It is capable of handling short (16 bit), long (32 bit), double (64 bit), and temporary (80 bit) numbers. It can rapidly process a number as high as 1.18×10^{332} and numbers as small as 3.36×10^{-332} .

The 8087 was designed to be compatible with and work along side either the 8086 or 8088. For example, using this combination, a computer can perform number crunching operations more than 1,000 times faster than other 8 bit microprocessors and more than 100 times faster than the newest Motorola 32 bit MC68000 microprocessor.

At this juncture let us refocus our perspective. We have deliberately stressed the good and "bad" points of certain microprocessors to make it easier to follow their evolutionary development. Don't be too hasty in forming any opinions about how bad a certain processor or family of processors may be. There is no such thing as a bad microprocessor. The most inexpensive, basic microprocessor you can buy is nothing less than an electronic marvel. What's more, the "worst" microprocessor can do virtually everything that the "best" one can do. The difference is that one will take more lines of code and will take a little longer to execute. In most cases the longer execution time is only a matter of a few seconds or less. And, as operators of

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multuser systems will testify, a "slow" processor in a personal computer often has a faster response than a multi-million dollar mainframe with many terminals tied to it.

In the next article we will be discussing current developments in computer technology that will affect the world of computers in the near future. Among other things, we will talk about a developmental CPU that will handle 80 bit words, directly address 1,000 Gigabytes of memory, and can completely be contained on one circuit board smaller than the dimensions of this page. The chip and its associated interfaces are scheduled to be ready for use in 1983.

We will also talk about software. We will address specific operating systems and programming languages and offer some fearless predictions. We will list things to look for and be wary of when buying a personal computer, and will wind up the article by naming your author's favorite computers.

Al Bailey ADØZ

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Santec 1200 2 meter HT-synthesized \$209.

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Swan FM 2X w/ac supply \$125.

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Icom 2030 synth. 2 mtr. \$150.

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BOARD MINUTES

The Nov. 15th board meeting was called to order in Bud's home a 7:40 p.m. Present were: Bud, Dave, Les, Mark, Jake, Charlie and Tom.

Discussion opened around the December Homebrew Night and the prizes to be offered. The board also firmed up plans for the Christmas Party December 3rd. Members are reminded that Greg must have the money — \$12.00 per person — by December 1st in order to reserve a place. Postcards will be sent to all members.

Upcoming programs were the next item. Tentatively, in addition to Homebrew Night, the Dec. meeting will continue Ray's, AAOL, presentation from November.

Possible locations for Swapfest were discussed. The kinds of prizes were also considered. A need to begin early on this project was expressed. Hopefully, April 24th can be reserved for this big event.

Many hams will be needed to help with the 1983 Sports Festival. A letter will be sent to area hams in the near future for their help with communications and with the commemorative station.

Possible purchase of business cards was discussed as the result of a member's suggestion at the club meeting. This idea seemed to be well received by the board. Cost for 1000 cards would be in the \$20 range. Dave agreed to explore this issue in more depth.

The Board expressed the desire to congratulate Don & Joyce Lohse on the Nov. 10th birth of their son Charles Frederick who weighed in at 6 lbs. 2 oz.

There being no further business before the board, the meeting adjourned at 9:30 p.m. Next meeting will be Dec. 13th at Dave's home.

Respectfully submitted,
Mark, KAØJXW



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